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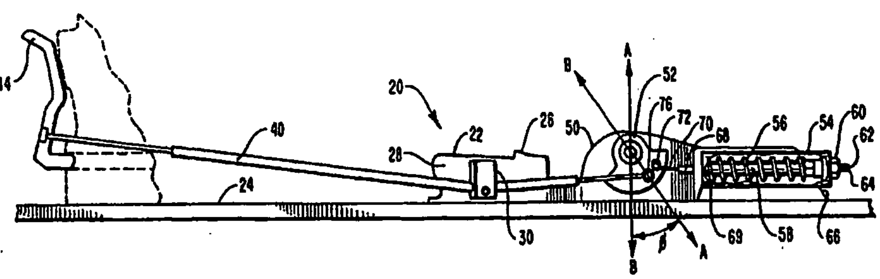

(57) Abstract

A telemark ski binding having a pre-compressed spring (56) augmenting the forces imposed on the heel of a boot by the cable (40) looped therearound, when the heel is in a heel low position, and resisting the forces imposed on the heel, when the heel is in a high heel position, in order to achieve a selected force acting upon the heel as the heel travels within a range of motion between the heel low and the heel high positions. The pre-compressed spring (56) imparts the selected force to the heel by continually biasing an energy transfer element (52) in a direction away from a movement imposed upon the energy transfer element (52) by the cable (40) attached thereto. The selected force is preferably substantially uniform throughout the range of motion but may also be substantially linearly increasing or decreasing as the heel travels from the heel low position to the heel high position. No matter which selected force is implemented, the force acting on the heel is relatively high when the heel is in the heel low position and is relatively low when the hell is in the heel high position.

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PRE-COMPRESSED SPRING SKI BINDING

BACKGROUND OF THE INVENTION

1. The Field of the Invention

The present invention relates generally to cross-country and telemark ski bindings and particularly relates to an improved ski binding having a pre-compressed spring therein for achieving a selected force on a heel portion of a ski boot while simultaneously improving skier stability and control.

2. The Relevant Technology

Cross-country skiing has been a popular form of recreation and physical fitness for nearly one hundred years. Since its genesis in Norway at the turn of the twentieth century, the principles guiding cross-country skiing have remained virtually unchanged. For example, cross-country skiing was performed then, as now, with a toe of a ski boot attached to an elongated ski and with a heel portion of the boot free to rotate upward and forward about the toe so that skiers could propel themselves around on snow in a stride resembling a walking stride. Even though advancements over time have been made, the concept of binding the toe still remains valid and many present-day binding styles still incorporate the concept.

One such present-day binding, popularly known as the three-pin, attaches the toe to the ski by mating three holes on the underside of the toe to three corresponding pins on the binding which is, in turn, attached to the ski. The three-pin, while generally a very effective toe binding, allows unwanted excess lateral slippage of the unbound heel resulting in rotation of the elongate ski about the toe region thereby adversely impacting skier control.

Lateral heel slippage is also a problem with another form of skiing known as telemark skiing. Telemark skiing, which is generally characterized as downhill traversal, necessarily requires a skier to carve an edge of the ski into the snow in order to maintain control. Thus, rotation of the ski, caused by lateral heel slippage, almost entirely eliminates the skier's ability to carve the edge and maintain good control.

Another problem with the unbound heel for telemark skiers is that of rotational inertia. The problem exists because the ski is elongate and is bound to the boot only by the toe portion, at an approximate mid-point of the ski, and no means are present that can keep the heel portion of the boot in close proximity with the ski which is essential for maintaining control and effectuating telemark style turns.

In an effort to remedy the foregoing inadequacies of the unbound heel, telemark ski equipment began adopting features from the more traditional downhill skiing style, known as alpine. Most notably, telemark equipment adopted a modified heel-binding mechanism.

The basic heel binding mechanism is essentially a cable, secured at its extremities on both sides of the toe portion of the boot to form a loop for wrapping around the heel of the boot. The toe portion of the boot firmly fits underneath a toe clamp and/ or between a pair of lateral support clamps. The cable typically has two lateral springs positioned on opposite sides of the boot to maintain a positive force against the heel and toward the toe to ensure that the toe portion remains snugly secured within the clamp(s). In general, the cable function is twofold. First, the cable provides a minimum force when the skier's boot is in a "heel low" position, i.e., a substantially flat position on the ski, to prevent lateral heel slippage so that typical cross-country style (heel unbound) skiing can be performed. Second, the cable provides an increased force when the skier's boot is in a "heel high" position, i.e., a substantially perpendicular position to the ski, such as occurs during execution of telemark style turns, to overcome inertia and help maintain close proximity and alignment between the heel and the ski.

Although the cable binding system represents an advancement in binding technology, the cable binding system is still plagued by shortcomings. For example, a typical force exerted by a conventional cable binding on the heel of the ski boot, and ultimately the skier's leg, when in the heel low position is often around 35 pounds. While better than a toe binding having an unbound heel, the force is still too little to overcome much of the undesirable heel slippage. Conversely, when the boot is in the heel high position, the force exerted by the conventional cable binding on the heel very often reaches 165 pounds or more. Such high forces, while keeping the heel and ski in close proximity and alignment, not only exerts immense pressure on the skier's legs but frequently transfers to the toe portion of the boot with sufficient force to overcome the stiffness of the toe of the boot and cause the solid toe portion of the boot to collapse onto the skier's foot. This very painful phenomenon is known commonly to skier's as "toe crunch" and sometimes causes severe injury. In addition, the tremendous vacillation of forces exhaustively depletes the skier's stored energy as the heel travels between the heel low and heel high positions.

Yet another problem with cable bindings is that the cable pivots, as the heel is raised, at a position on the ski that is spatially distanced from where the toe of the boot pivots upon the ski. This relationship of pivot points causes a moment-arm effect resulting in the phenomenon known to skier's as "tip dive," wherein the ski tip is caused

to precipitously rotate downwardly into the snow. Tip dive generally unsettles the skier and may often cause a fall.

SUMMARY OF THE INVENTION

In accordance with the invention as embodied and broadly described herein, the embodiments are achieved by providing a telemark ski binding having a pre-compressed spring augmenting the forces imposed on the heel of the boot by the cable looped therearound, when the heel is in the heel low position, and resisting the forces imposed on the heel, when the heel is in the heel high position, in order to achieve a selected force acting upon the heel as the heel travels within a range of motion between the heel low and the heel high positions. The pre-compressed spring imparts the selected force to the heel by continually biasing an energy transfer element in a direction away from a movement imposed upon the energy transfer element by the cable attached thereto. The selected force is preferably substantially uniform throughout the range of motion but may also be substantially linearly increasing or decreasing as the heel travels from the heel low position to the heel high position. No matter which selected force is implemented, the force acting upon the heel is relatively high when the heel is in the heel low position and is relatively low when the heel is in the heel high position.

In a preferred embodiment, the selected force is achieved by attaching a pre-compressed spring to a pivot mechanism, on one side thereof, in order to bias the pivot mechanism in a direction away from the movement imposed upon the pivot mechanism by the cable attached on the opposite side thereof.

In another preferred embodiment, the selected force is achieved by biasing a cap, positioned at the end of a pre-compressed spring, in a direction away from the movement imposed on the cap by the cable attached to the same side of the cap as the spring.

These features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to more fully understand the manner in which the above-recited and other advantages of the invention are obtained, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention in its presently understood best mode for making and using the same will be

described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a side view of a ski binding in accord with the present invention in the heel low position having a partial cut-away view of the pre-compressed spring;

Figure 2 is a top view of the ski binding of Figure 1;

Figure 3-A is a side view of a portion of the ski binding of Figure 1 in the open position;

Figure 3-B is a side view of the ski binding of Figure 1 in the heel high position;

Figure 4 is a side view of a pivot mechanism in accord with an alternative embodiment of the present invention;

Figure 5 is a side view of a ski binding in accord with an alternative embodiment of the present invention; and

Figure 6 is a side view of the ski binding of Figure 5 in the heel high position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a novel pre-compressed spring construction for a ski binding that achieves a selected amount of force imposed upon a heel of a ski boot as the heel travels through a range of motion from a "heel low" position with the boot being nearly parallel to the ski to a "heel high" position with the boot being substantially perpendicular to the ski, and back again through the range of motion in the opposite direction.

With reference to Figures 1 and 2, a ski binding according to the present invention is depicted generally as 20. The ski binding 20 has a toe iron 22 for mounting onto an elongate ski 24 by mechanical fastening means well known to those skilled in the art. The toe iron 22 has lateral catches 26 for firm securement of the peripheral edges of a toe portion of a ski boot (not shown). The lateral catches 26 of the toe iron 22 may be replaced, if desired, by conventional toe clamps, three-pin arrangements or any other useful structure facilitating securement of the toe portion of a ski boot to a ski binding.

Connected to an outside face 28, on each side of the toe iron 22, are hinges 30, 32 that permit a cable 40 to pivot with a heel portion of the ski boot as the heel portion is maneuvered by a skier during usage. While the partial depiction of the heel of a ski boot is useful in facilitating understanding of the present invention, the ski boot itself is not considered part of this invention and is therefore illustrated with dashed lines. At the heel portion of the ski boot, the cable 40 cooperates with a tensioning lever 44 that assists the skier during the mounting of the ski boot to the ski binding 20. After mounting, the tensioning lever facilitates securement of the toe portion of the ski boot to the toe iron 22

as the tensioning lever 44 engages the heel portion of the ski boot. In addition, the tensioning lever 44 is fashioned in such a manner as to avoid impeding the movement of the heel portion as the heel portion is rotatingly maneuvered by the skier during usage. The cable 40 also cooperates with a length adjuster 48 so that the skier can vary the effective size of the loop 49 formed by the length of the cable 40 between the hinges 30, 32. What has heretofore been described is well known within the art of ski bindings and has merely been described as background in order to identify the common elements between a conventional ski binding and the present invention.

Securely connected with toe iron 22, either integrally or by way of cable 40 (Figure 3-A), is a housing 50. The housing 50, when connected by way of cable 40, is also mounted to the elongate ski 24 by mechanical fastening means well known to those skilled in the art. When the housing 50 is integrally formed with the toe iron 22, it is only necessary that one mounting means be effectuated for the integrally connected elements. The housing 50 is provided to stabilize an energy transfer element that is described in detail below. Suitable materials for manufacturing toe iron 22 and housing 50 preferably include aluminum, stainless steel, plastic or other similar lightweight materials possessing high strength.

Mounted substantially adjacent to the housing 50, on a side opposite of the toe iron 22, is a tube 54 that contains a spring 56, preferably made of an elastomer, configured in a helical wind about a center piece 58. When non-deformed, the spring 56 is substantially longer in length than the tube 54, thus fitting the spring 56 into the interior of the tube 54 causes substantial compression of the spring 56, hereinafter known as pre-compression. This pre-compression provides a potential source of energy that will eventually be used to augment or resist the forces of the cable 40 that act upon the heel portion of the ski boot. In a preferred embodiment, the tube 54 is substantially cylindrical in shape in order to cooperatingly contain the substantially cylindrical, helically wound spring 56. It will be appreciated, however, that other equally effective designs of the tube 54 and methods of compressing the spring 56 are available and are well known to those skilled in the art.

Located within the tube 54 about the center piece 58 is an end stop 66 that is mounted in a manner that allows for additional compression of the spring 56 after the spring 56 has been pre-compressed. Additional compression occurs when the end stop is caused to move laterally along the center piece 58 in a direction towards the spring. The pre-compressed spring is also allowed to elongate when the end stop 66 is caused to move laterally in a direction away from the spring 56. This lateral movement, described below, is caused when a connection clamp 68 located exterior to, and on an opposite end

of, the tube 54 is moved. Mechanically assisting the connection clamp 68 in the movement of the end stop 66 is a line connector 69 that runs from the connection clamp 68 internally through the center piece 58 to the end stop 66. Alternatively, the end stop can be directly connected to the line connector without a supportive center piece.

Also connected to the connection clamp 68 is a wire 70 which, in turn, connects to a stud 72 fixedly attached on a pivot mechanism 52. It is the pivot mechanism 52 that ultimately causes movement of the end stop 66 along the center piece 58 in a direction towards, or away from, the spring 56. It should be appreciated that the connection clamp 68, the wire 70 and the stud 72 are exemplary embodiments of mechanical fasteners well known to those skilled in the art that fundamentally achieve interconnection between the end stop 66 and the pivot mechanism 52. Again, numerous substitutes exist that could facilitate this interconnection. For example, it would be possible to weld the wire 70 and the line connector 69 together to form one coextensive piece or to eliminate the wire 70 and the connection clamp 68 altogether and adapt stud 72 to directly receive an extending end 74 of the line connector 69 (Figure 3-A).

Also mechanically affixed to the pivot mechanism 52, by way of a pair of oppositely disposed inserts 76, 78, is the cable 40. The inserts 76, 78 are each configured to receive an appropriate length of cable 40 either from terminal ends 80, 82 of the cable 40 or simply by looping a portion of the cable therethrough. The inserts 76, 78 are also exemplary of one suitable type of fastening means. Other suitable alternatives include a singular, one-sided insert for receiving both terminal ends 80, 82 or for receiving one of the terminal ends if the other terminal end were secured elsewhere. Rivets, clamps, welding, bonds or any other suitable means known in the art could also be utilized.

The pivot mechanism 52 is rotatably mounted to the elongate ski 24, preferably about a hub 84 that is in turn fixedly attached to the housing 50. Alternatively, the hub 84 may be mounted directly to either the elongate ski 24 or the toe iron 22 or by any other means that would allow for substantially unimpeded mechanical rotation of the pivot mechanism 52. In this preferred embodiment, both of the inserts 76, 78 and the stud 72 are about 0.7 inches in their respective straight-line distances from their center points to a center point on the hub 84.

It should be understood that the pivot mechanism 52 is, broadly, an energy transfer element that allows for a productive transfer of energy between the pre-compressed spring 56 and the cable 40 so that the cable forces acting upon the heel of the ski boot, during operation, are either ultimately augmented or resisted by the pre-compressed spring. The energy transfer between the pre-compressed spring and the cable

will now be described with particular reference to the angles theta, θ, and alpha, α, in Figures 1, 3-A, and 3-B.

The angle theta, is the angular distance between line A-A (the perpendicular line formed by the hub 84 and the elongated ski 24) and the line B-B, formed by connecting the hub 84 with the insert 76. The angle alpha, α, is the angular distance between the line B-B and the line C-C formed by connecting the hub 84 and the stud 72. Because the insert 76 and the stud 72 are both fixed relative to the hub 84, the angle alpha is constant and will preferably be approximately 25°. Angle alpha is only illustrated in Figure 3-A.

When the ski binding 20 is not being used by a skier, it is in the "open" position (Figure 3-A). In the open position, there is no energy transfer between the spring and the cable because the pivot mechanism 52 is static. The spring 56 pre-compressed within the tube 54, however, possesses potential energy that serves to bias the pivot mechanism 52 in a rotational direction towards the spring 56 in the event that a force is eventually imparted to the pivot mechanism 52. The angle theta in the open position is preferably approximately 45 degrees. When forces are applied to the pivot mechanism 52 by the cable 40, as the cable accompanies the heel during operation of the ski binding, the static state of the pivot mechanism 52 is overcome and the angle alpha is caused to swivel between a range of angular variations. The two extremes correspond to the two extremes of heel motion, a "heel low" and a "heel high" position. In a "heel low" position (Figure 1), i.e., when both the toe portion and the heel portion are in substantially parallel alignment with the elongated ski 24, the angle theta decreases to about 30 degrees. The decrease in angle is due to the cable 40 rotating the pivot mechanism 52 about the hub 84 in a clock-wise direction. The rotation of the pivot mechanism 52 imparts proportional clock-wise rotation to the stud 72 and, as a result, the line connector 69 pulls the end stop 66 toward the spring. The spring 56 thence becomes further compressed within the tube 54. Although some force has been used to effect the further compression of the spring 56, the spring bias force is nevertheless predominantly pushing against the end stop and is, thus, augmenting the cable forces pulling away from the heel of the ski boot.

The augmented force is now larger in magnitude than the force of conventional cable bindings in the heel low position. The augmented force is also sufficient in magnitude to more effectively secure the toe portion of the ski boot to the toe iron 22. In this manner, the lateral heel slippage problems associated with the conventional cable binding mechanisms are substantially decreased to convincingly improve skier stability and control.

It should be appreciated that, in either the open or the heel low position, the initial force imposable upon the pre-compressed spring 56 can be altered in finite amounts, according to an individual skier's preference, if desired, by a compression variation knob 60. The compression variation knob 60 is rotatingly mounted about a shaft 62 and is used to increase or decrease the amount of pre-compression by being respectively turned in the clockwise or counter-clockwise directions along the threads 64 of a shaft 62. The turning of the compression variation knob 60 along the threads 64 consequentially causes the shaft 62 to move laterally into or out of the tube 54. This lateral movement then correspondingly causes the end stop 66 to move in a direction towards, or away from, the spring 56. As the end stop 66 incrementally moves in the direction of the spring 56, the spring 56 is additionally compressed between the end stop 66 and the housing 50. Conversely, the spring 56 is elongated when the end stop 66 moves in a direction away from the spring 56. It is again contemplated by the present invention that mechanical alternatives exist that would similarly allow for variations in refining the amount of initial spring compression achieved. Such alternatives include, but are not limited to, mounting the compression variation knob directly to the line connector, moving levers, ratchets, gears, winch-like turning devices and any other suitable device or, as is further contemplated, by electro-mechanical devices.

In the heel high position (Figure 3-B), i.e., when the heel portion of the ski boot has been rotated about the toe region and the cable 40 has been rotationally bent about hinges 30, 32 into a substantially perpendicular alignment with the elongated ski 24, the angle theta, having rotated through line A-A, is now about 40 degrees to the opposite side of perpendicular line A-A, or negative forty degrees (-40°). As the pivot mechanism 52 rotates clock-wise in response to the cable 40 pulling the insert 77, the stud 72 is also caused to rotate clock-wise thereby even further compressing the spring 56 in the manner described above. The more the spring is compressed, however, the more the spring resists further compression and the stronger the force against the direction of compression becomes. In order to continue compressing the spring, a substantial portion of the force of the heel of the ski boot pulling upwardly on the cable must be transferred to the connection clamp, wire connector and end stop.

The further compression of the spring 56 now, contrastingly, serves to resist the force of the cable 40 acting upon the heel portion of the ski boot. In this manner, a significant portion of conventional cable forces has been displaced from acting upon the heel portion and the skier's legs. The resistance force imposed upon the heel, while smaller in magnitude as compared to forces exerted by conventional cable bindings, is sufficient to keep the ski in desirable proximity with the heel but simultaneously, the

substantially lower resistance force eliminates both toe crunch and the immense pressure on the skier's legs.

It should be appreciated that while the spring 56 augments the cable forces, in the heel low position, and resists the cable forces, in the heel high position, the spring 56 continually biases the pivot mechanism 52 in a direction away from the movement imposed upon the pivot mechanism 52 by the cable 40 in order to achieve a particular selected force acting upon the heel portion as the heel travels within the full range of motion between the extreme, heel low and heel high, positions. In a preferred embodiment, the selected force is substantially uniform as the heel portion travels within the full range of motion between the heel low and heel high positions.

It should be appreciated that the interrelationships herein described between the pivot mechanism, the spring and the cable should not be construed as limiting but merely as representative. The positioning of the spring 56 and the cable 40 about the pivot mechanism 52 could easily be altered into other mechanically advantageous positions so that additional selected forces could be achieved on the heel portion by the pre-compressed spring. For example, with reference to Figure 4, a substantially linearly increasing force is achieved, as the heel travels from the heel low to the heel high positions, by altering the stud 72 to be in substantially co-axial alignment with the insert 76, in the open position. It should also be appreciated that such alignment could also be achieved by eliminating the stud and securing the wire 70 directly within the insert 76. Although the selected force is increasing substantially linearly, it should be appreciated that the forces acting on the heel are nevertheless relatively higher than conventional bindings in the heel low position and are relatively lower than conventional bindings in the heel high position.

Still other forces acting on the heel portion can be selectively achieved by further altering the positioning of the mechanical parts, such as a force that substantially decreases from a high force in the heel low position to a low force in the heel high position. The selected force actually implemented primarily depends upon skier preference and the relative positioning of the mechanical connections about the pivot mechanism 52, of which, numerous alterations could be advantageously implemented so that the necessary mechanical connections are achieved. Particularly contemplated are interconnected gears responding to the biasing of the spring 56 and the forces applied by the cable 40 and a one-piece rotating device constructed with at least one spoke extending from the hub 84 that facilitates connection of the spring 56 and the cable 40 thereto. It is even contemplated that direct interconnection of the spring 56 and the cable 40 would yield suitable selected forces acting upon the heel of the boot.

It is intended that all such alterations are within the scope and spirit of the present invention. It is a fundamental teaching of the present invention that a selected force acting upon the heel can be achieved that (i) increases force to avoid heel slippage in the heel low position; (ii) decreases force to eliminate the toe crunch of the ski boot when the heel is in the heel high position; and (iii) vastly enhances the overall skiing experience by providing a selected force, preferably a substantially uniform force, on the heel throughout a range of motion between the heel low and heel high positions when compared to forces exerted by conventional cable ski bindings.

The present invention as described herein also reduces the problem of tip dive. With reference to Figures 3-A and 3-B, it can be seen that, when the pivot mechanism 52 is clock-wise rotated by the cable 40 from the open position (Figure 3-A) to the heel high position (Figure 3-B), the force of the forward-acting moment arm caused by the cable 40 acting about the hinge point 30, is lessened because the cable distance between the hinge point 30 and the insert 76 is not fixed and becomes less during this maneuver. The tendency of the ski tip to be propelled downward into the snow, when the heel is raised, is thence also lessened.

An alternative embodiment of an improved ski binding in accord with the present invention is illustrated in Figures 5 and 6. The improved ski binding is still arranged so that energy is transferred between a pre-compressed spring and a cable. In similar fashion, a pre-compressed spring continually biases an energy transfer element in a direction away from a movement imposed upon the energy transfer element by a cable in order to achieve a selected force acting upon the heel. In this particular embodiment, the energy transfer element is a cap and energy transfer is accomplished by a pre-compressed spring arrangement 120 operated upon by a substantially lateral movement of a cable 140.

It will be appreciated that, as described above for conventional ski bindings and generally in accord with Figure 1, the cable 140 is formed into a loop that is, preferably, looped through a toe mount (not shown) for a ski boot (not shown) in a manner that permits the remaining cable to be looped around the heel of the ski boot. The pre-compressed spring arrangement 120 comprises a spring 156 that is helically coiled within a housing 150. The spring has a cap 152 inserted into its interior at one end and a spring terminus 176 at the other end. A front end 155 of the housing forms a stop for the cap 152 that, in turn, forms a first stop for the spring 156. At the opposite end of the housing, an end wall 192 forms the second stop for the spring 156. The end wall 192 has a bore 177 therethrough that slidably engages the cable 140. The pre-compressed spring arrangement is incorporated into the loop formed by the cable such that a portion of the

cable loop is replaced by the pre-compressed spring arrangement 120. In other words, the cable loop is opened to form two cable ends for connecting to the pre-compressed spring arrangement. The front end 155 of the housing 150 securely receives the first cable end 144. The second cable end 154 is secured to the cap 152. The tension of the spring 156 is adjusted to achieve a desired effect on the force applied by the cable to the heel of the skier's boot. As shown in Figure 5, the coiled spring 156 is normally biased to push the cap 152 against the front end 155 of the housing when the ski binding is at rest such that second cable end 154 is pulled substantially through the interior of the pre-compressed spring arrangement. It will be appreciated that, when a skier places a boot in the ski binding, the cable will desirably become tensioned to securely hold the ski boot and that this tension will be augmented by the spring bias force. Thus, in the heel low position, compared to conventional ski bindings, the force applied to the heel is relatively greater.

As shown in Figure 6, a force applied to the cable in the opposite direction of the spring force (such as occurs as the skier raises the heel of the ski boot) causes the cap 152 to be pulled toward the end wall 192 and the spring 156 to be compressed further. In this manner, the spring absorbs a portion of the increasing force on the cable and, thus, prevents the transfer of the entire increasing force to the heel of the ski boot. Thus, in the heel high position, compared to conventional ski bindings, the force applied to the heel is relatively less.

As before, it should be appreciated that the spring 156 continually biases the energy transfer element, the cap 152, in a direction away from the movement imposed upon the cap 152 by the cable 140 in order to achieve a particular selected force acting upon the heel portion as the heel travels within the full range of motion between the extreme, heel low and heel high, positions. In a preferred embodiment, the selected force is substantially linearly increasing as the heel portion travels within the full range of motion between the heel low and heel high positions. In this embodiment, it still remains a fundamental teaching that the selected force acting upon the heel is achieved in a manner that (i) increases force to avoid heel slippage in the heel low position; (ii) decreases force to eliminate the toe crunch of the ski boot when the heel is in the heel high position; and (iii) vastly enhances the overall skiing experience by providing a selected force on the heel throughout a range of motion between the heel low and heel high positions when compared to conventional ski bindings.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the

invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

1. A pre-compressed spring arrangement for a ski binding that attaches a ski boot, having a heel portion and a toe portion, to an elongate ski, comprising:

an energy transfer element;

a spring being capable of substantial compression for biasing said energy transfer element; and

a cable for looping around said heel portion in order to facilitate securement of said toe portion, said cable attachable to said energy transfer element,

wherein during operation, said spring is substantially compressed and continually biases said energy transfer element away from a movement imposed upon said energy transfer element by said cable in order to achieve a selected force acting upon said heel portion as said heel portion travels throughout a range of motion from a heel low position to a heel high position.

2. A pre-compressed spring arrangement according to claim 1, wherein said selected force is substantially uniform as said heel portion travels through said range of motion.

3. A pre-compressed spring arrangement according to claim 1, wherein said selected force is substantially linearly increasing as said heel portion travels from said heel low position to said heel high position.

4. A pre-compressed spring arrangement according to claim 1, wherein said energy transfer element is a pivot mechanism adapted for pivotally mounting to said elongate ski.

5. A pre-compressed spring arrangement according to claim 4, wherein said pivot mechanism is rotatably mounted about a hub.

6. A pre-compressed spring arrangement according to claim 1, further comprising a toe iron adapted for receiving said toe portion, said toe iron being attachable to said elongate ski.

7. A pre-compressed spring arrangement according to claim 1, further comprising a tube, said spring being substantially longer in length than said tube so that during operation, said spring is fitted within said tube in order to achieve said substantial compression.

8. A pre-compressed spring arrangement according to claim 1, further comprising a compression variation device in order to adjust the amount of compression imposable upon said spring.

9. A pre-compressed spring arrangement according to claim 8, further comprising a tube, said spring being substantially longer in length than said tube so that

during operation, said spring is fitted within said tube in order to achieve said substantial compression; a knob rotatingly mounted about a shaft partially within said tube so that as said knob is rotated, said shaft moves in a manner such that an end stop within said tube is caused to laterally move in one of a direction towards said spring and away from said spring thereby causing varied compression of said spring.

10. A pre-compressed spring arrangement according to claim 1, further comprising a pair of oppositely disposed inserts fixedly attached to said energy transfer element in order for each one of said oppositely disposed inserts to receive an appropriate length of said cable thereby effectuating attachment of said cable to said energy transfer element.

11. A pre-compressed spring arrangement according to claim 1, further comprising a stud fixedly attached to said energy transfer element in order to facilitate biasing of said energy transfer element by said spring.

12. A pre-compressed spring arrangement according to claim 11, wherein said stud receives a wire from one side of a connection clamp, said connection clamp having on another side thereof an end stop for applying additional compression to said spring during operation.

13. A pre-compressed spring arrangement according to claim 1, wherein said energy transfer element is a cap slidably housed within a container that is mounted about said spring.

14. A ski binding kit for use with a ski binding having a toe iron and a cable for tensioning a ski boot having a heel and a toe portion to an elongate ski, comprising:

an energy transfer element attachable to said cable; and

a spring adapted for substantial compression thereof for biasing said energy transfer element;

wherein during operation of said ski binding, said spring is substantially compressed and continually biases said energy transfer element away from a movement imposed upon said energy transfer element by said cable in order to achieve a selected force acting upon said heel portion of said ski boot as said heel portion of said boot travels within a range of motion between a heel low position and a heel high position.

15. A kit according to claim 14, wherein said selected force is substantially uniform as said heel portion travels between said range of motion.

16. A kit according to claim 14, wherein said selected force is substantially linearly increasing as said heel portion travels from said heel low position to said heel high position.

AMENDED CLAIMS

[received by the International Bureau on 13 October 1998 (13.10.98); original claims 1-16 replaced by new claims 1-18 (3 pages)]

What is claimed is:

1. A ski binding that attaches a ski boot, having a heel portion and a toe portion, to an elongate ski, comprising:

an energy transfer element;

a spring being capable of substantial compression for biasing said energy transfer element; and

a cable for looping around said heel portion in order to facilitate securement of said toe portion, said cable attachable to said energy transfer element,

wherein during operation, said spring is substantially compressed and continually biases said energy transfer element away from a movement imposed upon said energy transfer element by said cable in order to achieve a selected force acting upon said heel portion as said heel portion travels throughout a range of motion from a heel low position to a heel high position, said movement imposed upon said energy transfer element by said cable causing said spring to expand and compress in response thereto.

2. The ski binding according to claim 1, wherein said selected force is substantially linearly increasing as said heel portion travels from said heel low position to said heel high position.

3. The ski binding according to claim 1, wherein said energy transfer element is a pivot mechanism adapted for pivotally mounting to said elongate ski.

4. The ski binding according to claim 4, wherein said pivot mechanism is rotatably mounted about a hub.

5. The ski binding according to claim 1, further comprising a toe iron adapted for receiving said toe portion, said toe iron being attachable to said elongate ski.

6. The ski binding according to claim 1, further comprising a tube, said spring being substantially longer in length than said tube so that during operation, said spring is fitted within said tube in order to achieve said substantial compression.

7. The ski binding according to claim 1, further comprising a compression variation device in order to adjust the amount of compression imposable upon said spring.

8. The ski binding according to claim 8, further comprising a tube, said spring being substantially longer in length than said tube so that during operation, said spring is fitted within said tube in order to achieve said substantial compression; a knob rotatingly mounted about a shaft partially within said tube so that as said knob is rotated, said shaft moves in a manner such that an end stop within said tube is caused to laterally move in one of a direction towards said spring and away from said spring thereby causing varied compression of said spring.

9. The ski binding according to claim 1, further comprising a pair of oppositely disposed inserts fixedly attached to said energy transfer element in order for each one of said oppositely disposed inserts to receive an appropriate length of said cable thereby effectuating attachment of said cable to said energy transfer element.

10. The ski binding according to claim 1, further comprising a stud fixedly attached to said energy transfer element in order to facilitate biasing of said energy transfer element by said spring.

11. The ski binding according to claim 11, wherein said stud receives a wire from one side of a connection clamp, said connection clamp having on another side thereof an end stop for applying additional compression to said spring during operation.

12. The ski binding according to claim 1, wherein said energy transfer element is a cap slidably housed within a housing that is mounted about said spring.

13. A ski binding kit for use with a ski binding having a toe iron and a cable for tensioning a ski boot having a heel and a toe portion to an elongate ski, comprising:

an energy transfer element attachable to said cable; and

a spring adapted for substantial compression thereof for biasing said energy transfer element;

wherein during operation of said ski binding, said spring is substantially compressed and continually biases said energy transfer element away from a movement imposed upon said energy transfer element by said cable in order to achieve a selected force acting upon said heel portion of said ski boot as said heel portion of said boot travels within a range of motion between a heel low position and a heel high position, said movement imposed upon said energy transfer element by said cable causing said spring to expand and compress in response thereto.

14. A kit according to claim 13, wherein said selected force is substantially linearly increasing as said heel portion travels from said heel low position to said heel high position.

15. A ski binding for attaching a ski boot, having a heel portion and a toe portion, to an elongate ski, comprising:

a housing;

an energy transfer element within said housing;

a spring within said housing being capable of substantial compression for biasing said energy transfer element; and

a cable for looping around said heel portion in order to facilitate securement of said toe portion, said cable attachable to said energy transfer element and said housing,

wherein during operation, said spring is substantially compressed and continually biases said energy transfer element away from a movement imposed upon said energy transfer element by said cable in order to achieve a selected force acting upon said heel portion as said heel portion travels throughout a range of motion from a heel low position to a heel high position, said movement imposed upon said energy transfer element by said cable causing said spring to expand and compress in response thereto.

16. The ski binding according to claim 15, wherein said housing further comprises a front end and an end wall, said energy transfer element being biased by said spring within said housing from between said front end and said end wall as said movement is imposed upon said energy transfer element.

17. The ski binding according to claim 16, wherein said cable passes through one of said front end and said end wall to attach to said energy transfer element.

18. The ski binding according to claim 17, wherein said spring is positioned about said cable within said housing.

STATEMENT UNDER ARTICLE 19

Please amend the claims in the above-identified application by cancelling sheets 13-16 of this application which contain the claims and abstract. Please substitute therefore, sheets 13-16, attached hereto, which contain the new claims to be entered in this application. The abstract conforms to the suggested abstract accompanying the International Search Report.

The claims submitted herewith place this application into conformity with the claims of the corresponding U.S. application.

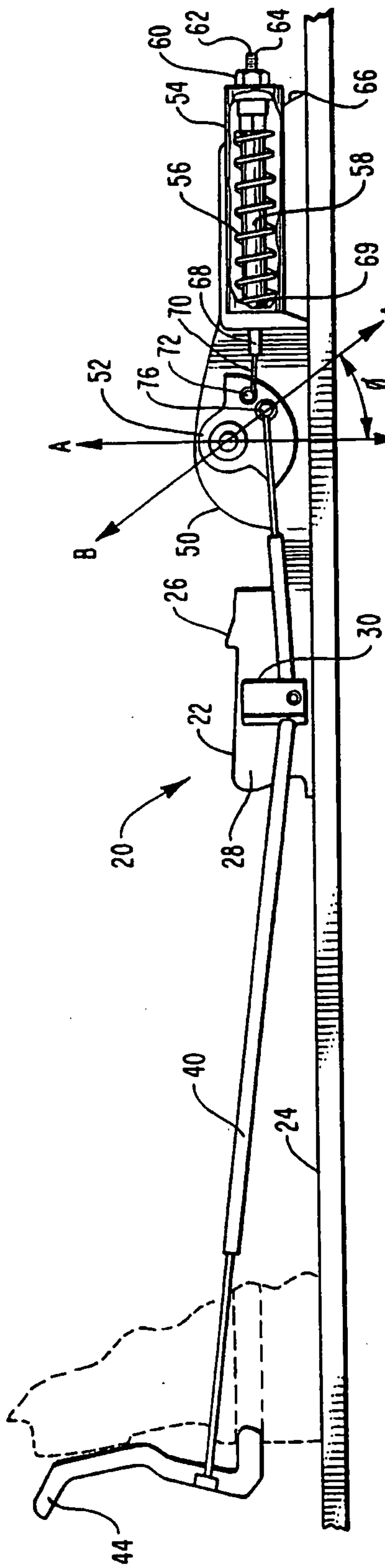

FIG. 1

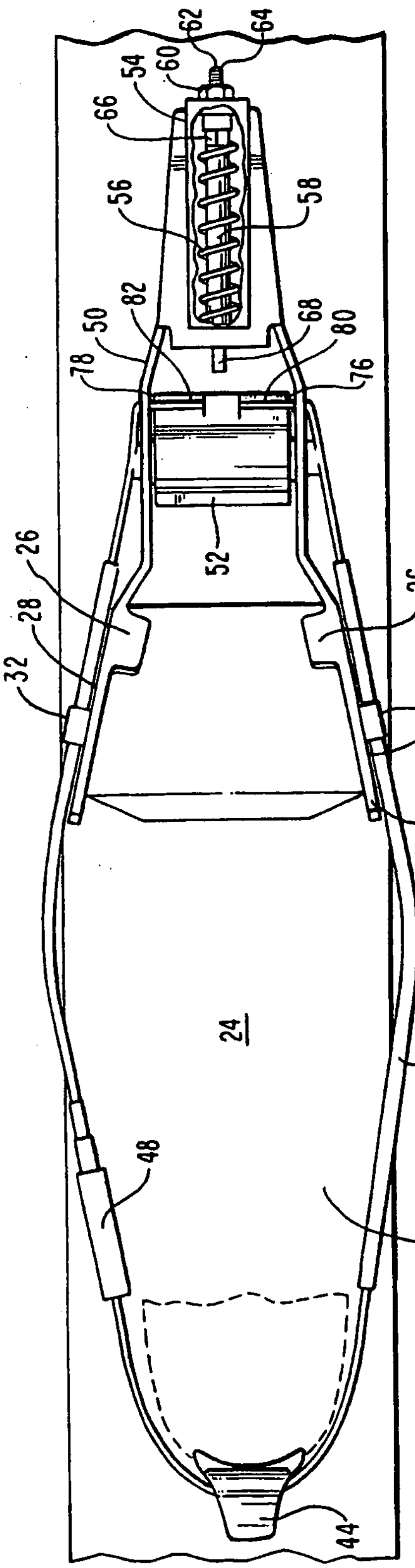

FIG. 2

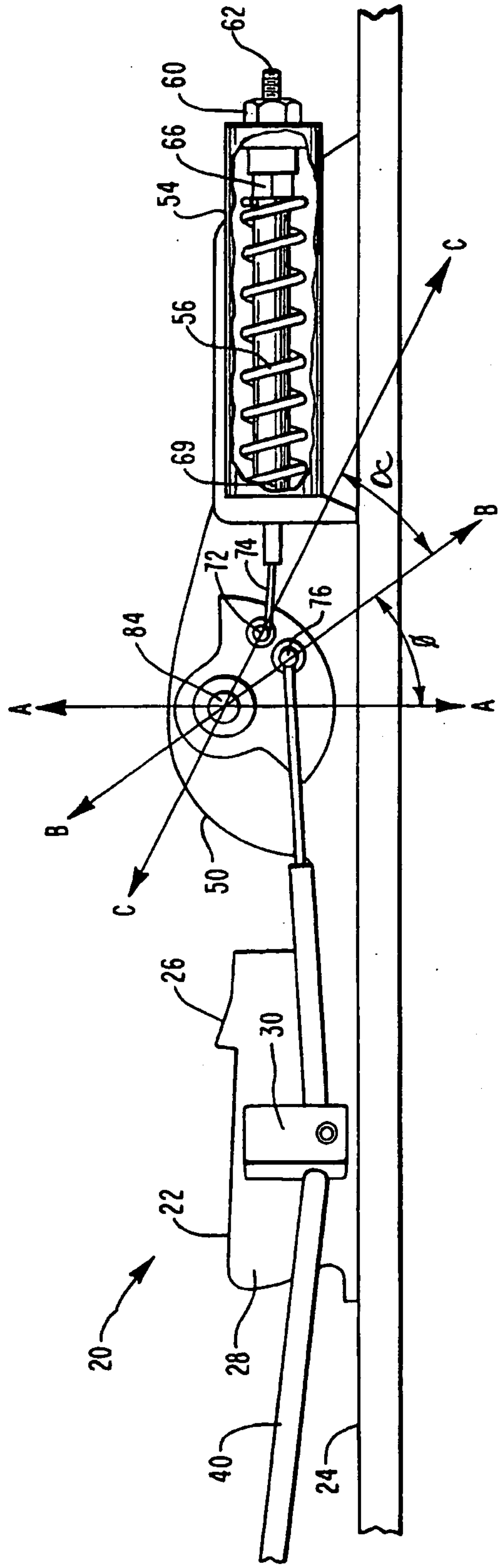
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FIG. 3A

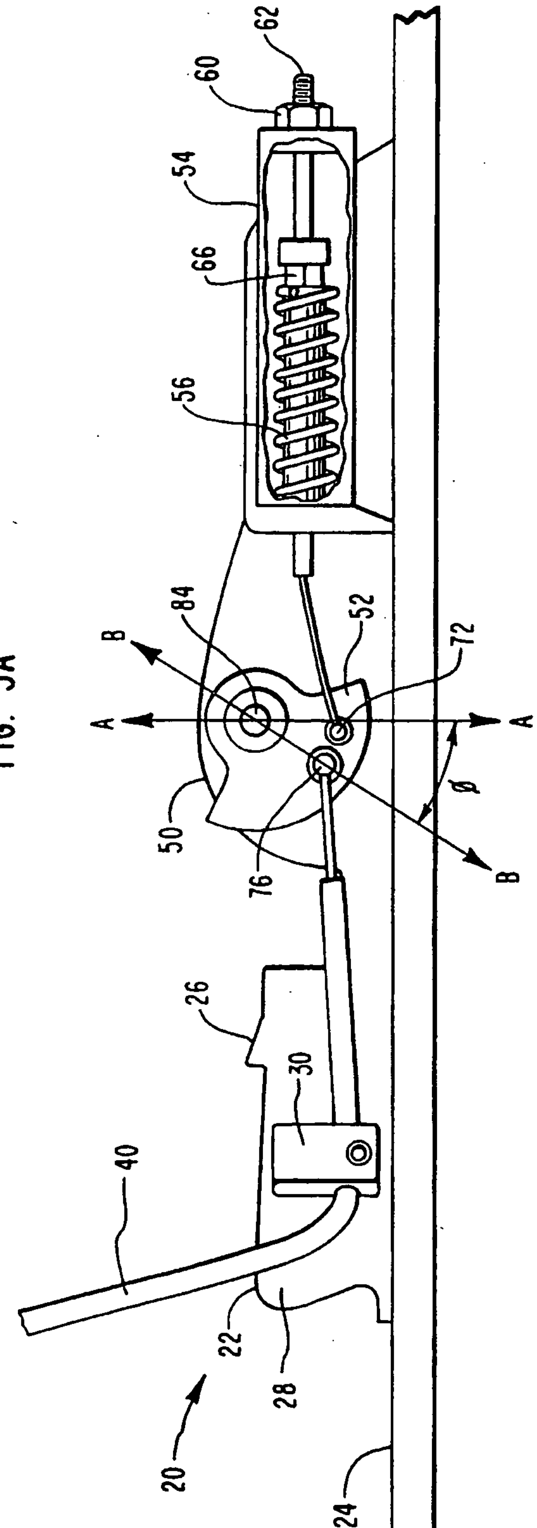
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FIG. 3B

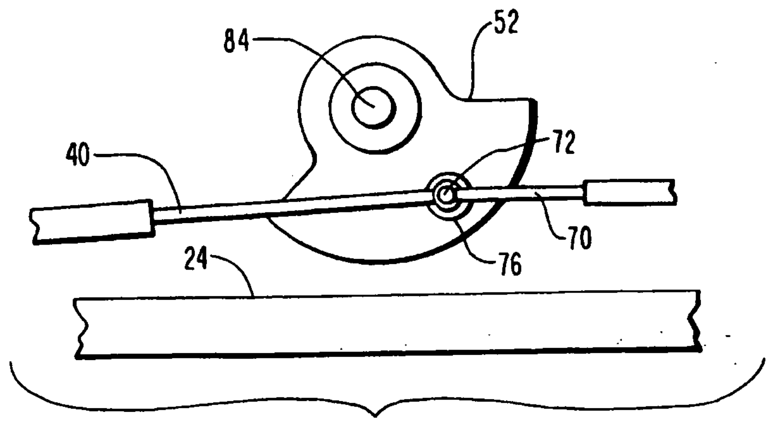

FIG. 4

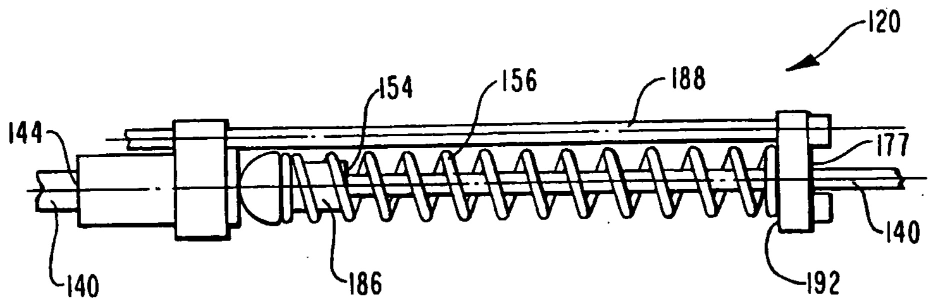

FIG. 5

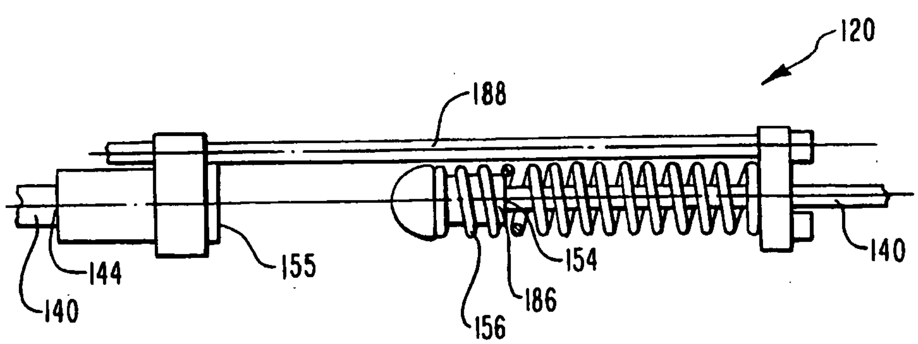

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/13441

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A63C 9/00
US CL :280/623, 615, 619, 634, 633, 614, 621
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 280/623, 615, 619, 634, 633, 614, 621

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

search terms: pre-compressed spring, ski binding

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,863,942 A (Burger) 04 February 1975 (04.02.75), see Figures 1 and 2.	1,2, 4-6, 8, 10-12, 14, 15
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Y		3, 7, 9, 13, 16
Y	US 5,499,838 A (Haughlin et al.) 19 March 1996 (19.03.96), see Figure 1.	3, 16
Y	US 2,698,757 A (Berlenbach) 04 January 1955 (04.01.55), see Figure 1.	7, 9
Y	US 3,191,955 A (Preisig) 20 June 1965 (29.06.65), see Figure 3.	13
A	US 4,322,090 A (Loughney) 30 March 1982 (30.03.82), see Figure 1.	1-16

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 AUGUST 1998	02 SEP 1998

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	JUDY SWANN Diane Smith for
Facsimile No. (703) 305-3230	Telephone No. (703) 306-4115

Form PCT/ISA/210 (second sheet)(July 1992)★

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,854,605 A (Emerson) 08 August 1989 (08.08.89), see Figures 1 and 8.	1, 3